Lower Middle Miocene Fan 1 (MM4 F1) Play

Gyroidina "K" through *Amphistegina* "B" biozones

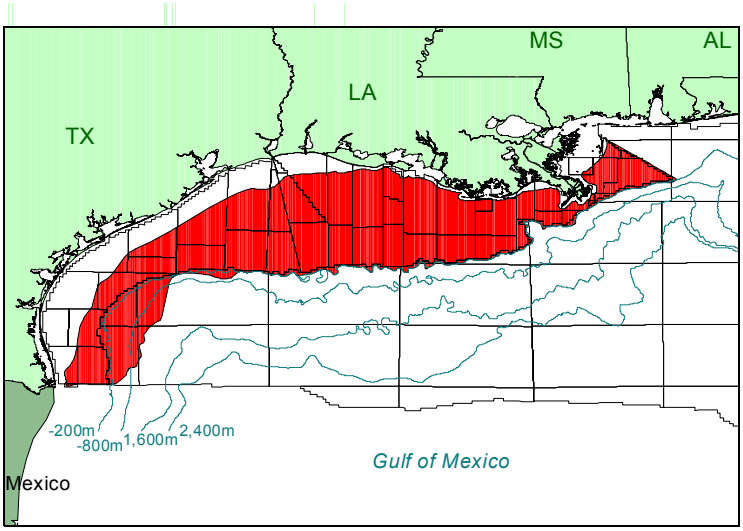

Figure 1. Play location.

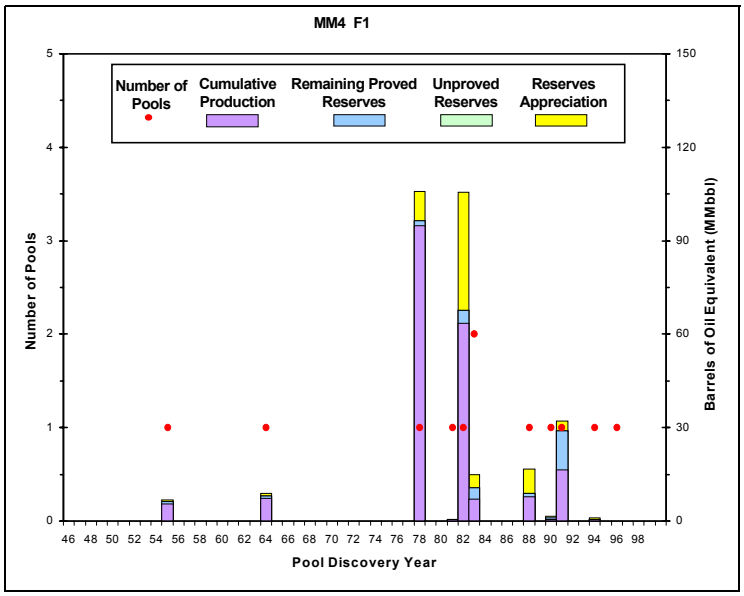

Figure 2. Exploration history graph showing reserves addition and number of pool discoveries by year.

MM4 F1 Play 12 Pools 30 Sands	Minimum	Mean	Maximum
Water depth (feet)	25	43	53
Subsea depth (feet)	10141	13946	18000
Number of sands per pool	1	3	8
Porosity	15%	22%	27%
Water saturation	19%	30%	56%

Table 1. Pool attributes. Values are volume-weighted averages of individual reservoir attributes.

Play Description

The established Lower Middle Miocene Fan 1 (MM4 F1) play occurs within the *Gyroidina* "K," *Cristellaria* 54/*Eponides* 14, *Robulus* 43, and *Amphistegina* "B" biozones. The play is also defined by deep-sea fan sediments in an extensional structural regime of salt-withdrawal basins and extensive listric faulting located on the modern Gulf of Mexico Region shelf. The MM4 F1 play extends from the South Padre Island and Port Isabel Areas offshore Texas to the Main Pass Area east of the present-day Mississippi River Delta (figure 1).

Updip, the MM4 F1 play continues onshore, except for in the South Padre Island to Vermilion Areas. In those areas the play is limited updip by the *Gyroidina* "K" shelf margin and the Lower Middle Miocene Progradational (MM4 P1) play. To the northeast the play onlaps the Lower Cretaceous carbonate slope. Downdip, the play is limited by the updip extent of the conceptual Lower Middle Miocene Fan 2 (MM4 F2) play.

Two separate depocenters were active during MM4 time in the Gulf of Mexico Region. The ancient North Padre Delta system provided sand to offshore Texas, and the ancient Calcasieu Delta System provided sand to offshore Louisiana. However, only sands of the Calcasieu Delta System of Louisiana have proven productive. Fan deposition in the underlying LM4 chronozone is better developed in the Mustang Island to Brazos Areas offshore Texas, while during MM4 time fans appear better developed farther east from the High Island to Vermilion Areas.

Play Characteristics

The productive MM4 F1 play is characterized by deepwater turbidites deposited in deep-sea channel/

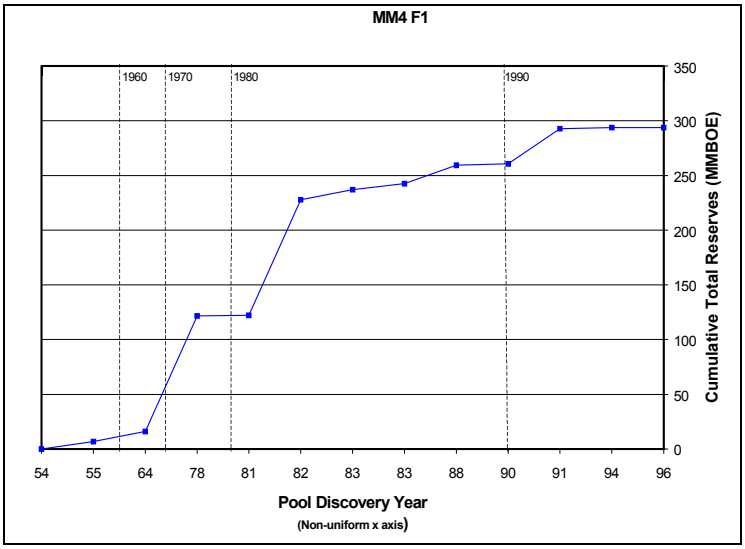

Figure 3. Plot of pools showing cumulative reserves by discovery order. Note the non-uniform x axis.

MM4 F1 Play Marginal Probability = 1.00	Number of Pools	Oil (Bbbl)	Gas (Tcf)	BOE (Bbbl)
Reserves				
Original proved	12	0.031	1.112	0.229
Cumulative production	--	0.027	0.994	0.204
Remaining proved	--	0.004	0.119	0.025
Unproved	0	0.000	0.000	0.000
Appreciation (P & U)	--	0.010	0.305	0.065
Undiscovered Conventionally Recoverable Resources				
95th percentile	--	0.023	1.268	0.253
Mean	48	0.038	1.594	0.321
5th percentile	--	0.058	1.947	0.398
Total Endowment				
95th percentile	--	0.065	2.685	0.547
Mean	60	0.080	3.011	0.615
5th percentile	--	0.100	3.364	0.692

Table 2. Assessment results for reserves, undiscovered conventionally recoverable resources, and total endowment.

levees, sheet-sand lobes, interlobes, fringe lobes, and slumps. Sediments were deposited on the MM4 upper and lower slope in topographically low areas between salt structure highs and on the abyssal plain. These deep-sea fan systems are often overlain by thick shale intervals representative of zones of sand bypass on the shelf, or sand-poor zones on the slope.

Normal faults are the dominant productive structural style in the MM4 F1 play. Seals are provided by the juxtaposition of reservoir sands with shales, either structurally (e.g., faulting) or stratigraphically (e.g., lateral shale-outs, overlying shales).

Discoveries

The MM4 F1 gas play contains total reserves of 0.042 Bbo and 1.417 Tcfg (0.294 BBOE), of which 0.027 Bbo and 0.994 Tcfg (0.204 BBOE) have been produced. The play contains 30 producible sands in 12 pools of which all contain proved reserves (table 1; refer to the Methodology section for a discussion of reservoirs, sands, and pools). The first reserves in the play were discovered in the East Cameron 49 field in 1955 (figure 2). Maximum yearly total reserves were added in 1978 with the discovery of the largest pool in the play (106 MMBOE) in the Vermilion 14 field. The play's second largest pool (105 MMBOE) was discovered in 1982 in the Vermilion 24 field. These two pools account for over 70 percent of the BOE total reserves in the play (figures 2 and 3). The most recent discovery, prior to this study's cutoff date of January 1, 1999, was in 1996.

The 12 discovered pools contain 33 reservoirs, of which 32 are nonassociated gas and 1 is undersaturated oil. Cumulative production has consisted of 87 percent gas and 13 percent oil.

Assessment Results

The marginal probability of hydrocarbons for the MM4 F1 play is

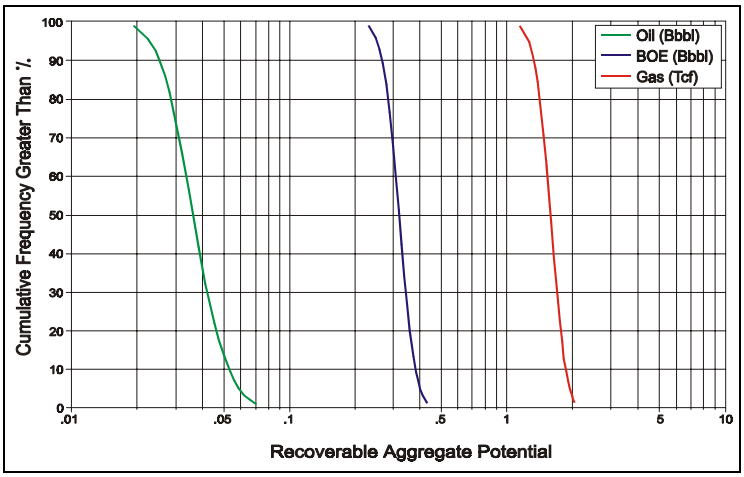

Figure 4. Cumulative probability distribution for undiscovered conventionally recoverable resources.

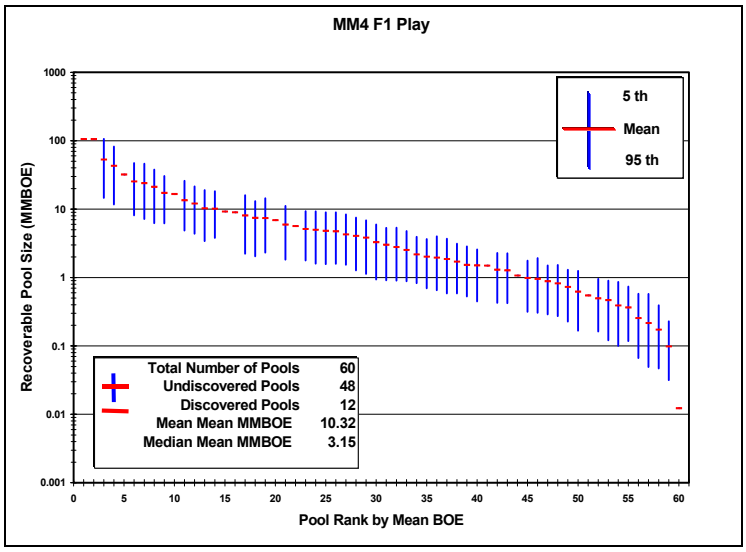

Figure 5. Pool rank plot showing the number of discovered pools (red lines) and the number of pools forecast as remaining to be discovered (blue bars).

1.00. The play contains a mean total endowment of 0.080 Bbo and 3.011 Tcfg (0.615 BBOE) (table 2). A third of this BOE mean total endowment has been produced.

Assessment results indicate that undiscovered conventionally recoverable resources (UCRR) have a range of 0.023 to 0.058 Bbo and 1.268 to 1.947 Tcfg at the 95th and 5th percentiles, respectively (figure 4). Mean UCRR are estimated at 0.038 Bbo and 1.594 Tcfg (0.321 BBOE). These undiscovered resources might occur in as many as 48 pools. The largest undiscovered pool, with a mean size of 53 MMBOE, is forecast as the third largest pool in the play (figure 5). The forecast places the next four largest undiscovered pools in positions 4, 6, 7, and 8 on the pool rank plot. For all the undiscovered pools in the MM4 F1 play, the mean mean size is 7 MMBOE, which is significantly smaller than the 24 MMBOE mean size of the discovered pools. The mean mean size for all pools, including both discovered and undiscovered, is 10 MMBOE.

The MM4 F1 play has not been extensively tested because of its great depth of burial. The most exploration potential is thought to exist on the flanks of salt bodies, and by drilling deeper in and around existing fields. BOE mean UCRR contribute 52 percent to the play's BOE mean total endowment.